Amendments to the Claims

1. (Currently amended) A low energy electron source for at least partially neutralizing space charge of a gas cluster ion beam, comprising:

one or more filaments for emitting electrons;

a filament power supply for biasing said one or more filaments to induce low energy electron emission;

an anode electrode for accelerating said electrons away from the one or more filaments and toward a gas cluster ion beam having an axis so as to have a neutralizing effect on the space charge of said gas cluster ion beam;

an acceleration power supply for biasing said anode electrode with respect to said one or more filaments;

a deceleration electrode for decelerating said accelerated electrons; and

~~means for biasing~~ wherein said one or more filaments each have a positively biased end and a negatively biased end and further wherein said deceleration electrode ~~with respect to said one or more filaments~~ is directly connected to the positively biased end of said one or more filaments.

2. (Original) The low energy electron source of claim 1, wherein:

the deceleration electrode is substantially cylindrical and substantially coaxial with the gas cluster ion beam axis, and is disposed between the anode electrode and the gas cluster ion beam; and

the anode electrode is substantially cylindrical and substantially coaxial with the gas cluster ion beam axis, and is disposed between said one or more filaments and the gas cluster ion beam.

3. (Original) The low energy electron source of claim 2, wherein the deceleration electrode includes an aperture for transmitting the gas cluster ion beam.

4. (Original) The low energy electron source of claim 2, further comprising:

a substantially cylindrical electron reflecting electrode that is substantially coaxial with the gas cluster ion beam axis;

a power supply for biasing the electron reflecting electrode with respect to said one or more filaments; and

wherein,

the one or more filaments are disposed between the electron reflecting electrode and the acceleration electrode, and

the electron reflecting electrode is biased so as to reflect electrons toward the acceleration electrode.

5. (Canceled)

6. (Original) The low energy electron source of claim 2, wherein:

at least a portion of the anode electrode comprises an electrically conductive mesh with an electron transparency of 90 per cent or more; and

at least a portion of the deceleration electrode comprises an electrically conductive mesh with an electron transparency of 90 per cent or more.

7. (Original) The low energy electron source of claim 2, wherein the decelerated electrons have energies of less than 10 electron volts.

8. (Original) The low energy electron source of claim 2, wherein the one or more filaments comprise two or more filaments disposed substantially parallel to the gas cluster ion beam axis and substantially equally spaced about the gas cluster ion beam.

9. (Original) A vented faraday cup, comprising:

an electrically conductive strike plate having a surface for receiving a gas cluster ion beam;

a vented enclosure surrounding and extending in front of the strike plate so as to define a cup, said enclosure comprised of a plurality of substantially coaxial electrically conductive ring electrodes disposed with gaps between the ring electrodes;

an electrical conductor for conducting the current collected by the strike plate to a current measuring system; and

wherein said plurality of electrically conductive ring electrodes are arranged and electrically connected in at least three groups of at least two ring electrodes, each group independently electrically biased so as to minimize undesired charged particle leakage into or out of the cup.

10. (Original) The vented faraday cup of claim 9, wherein the surface of the electrically conductive strike plate includes saw-tooth grooves.

11. (Original) The vented faraday cup of claim 9, wherein

a group of electrically conductive ring electrodes nearest the electrically conductive strike plate is biased negatively with respect to the strike plate; and

one or more of the at least three groups of electrically conductive ring electrodes is biased at the potential of the electrically conductive strike plate.

12. (Original) The vented faraday cup of claim 9, wherein

a group of electrically conductive ring electrodes nearest the electrically conductive strike plate is biased at a first negative potential with respect to the strike plate;

one or more of the at least three groups of electrically conductive ring electrodes is biased at the potential of the electrically conductive strike plate; and

at least one of the at least three groups of electrically conductive ring electrodes is biased at a second negative potential with respect to the strike plate.

13. (Original) The vented faraday cup of claim 10, wherein:

the electrically conductive strike plate is substantially circular;

the multiple electrically conductive ring electrodes are substantially circular;

the saw-tooth groves are substantially circular; and

the electrically conductive strike plate and the multiple electrically conductive ring electrodes and the saw-tooth groves are all substantially concentric with an axis of the gas cluster ion beam.

14. (Original) The vented faraday cup of claim 9, wherein the gaps between adjacent electrically conductive ring electrodes are smaller than the annular radial extent of the adjacent ring electrodes.

15. (Original) An improved system for gas cluster ion beam processing of surfaces of workpieces, comprising:

a vacuum chamber;

a gas cluster ion beam source disposed within the vacuum chamber for forming a gas cluster ion beam, said gas cluster ion beam having a beam axis;

a workpiece holder for holding a workpiece within the vacuum chamber and for placing the workpiece into the gas cluster ion beam for processing and for removing the workpiece from the gas cluster ion beam to terminate processing;

a low energy electron source within the vacuum chamber for neutralizing or partially neutralizing the space charge of the gas cluster ion beam; and

a vented faraday cup within the vacuum chamber for collecting the gas cluster ion beam current for measurement to control the processing of the workpiece.

16. (Original) The system for gas cluster ion beam processing of claim 15, wherein the low energy electron source comprises:

one or more filaments for emitting electrons;

an anode electrode for accelerating said electrons away from the one or more filaments and toward the gas cluster ion beam;

a deceleration electrode for decelerating said accelerated electrons;

a filament power supply for biasing said one or more filaments to induce electron emission;

an acceleration power supply for biasing said anode electrode with respect to said one or more filaments; and

means for biasing said deceleration electrode with respect to said one or more filaments.

17. (Original) The system for gas cluster ion beam processing of claim 15, wherein the vented faraday cup comprises:

an electrically conductive strike plate having a surface for receiving the gas cluster ion beam;

a vented enclosure surrounding and extending in front of the strike plate and comprising a multiplicity of electrically conductive ring electrodes disposed with gaps between the ring electrodes;

an electrical conductor for conducting the current collected by the faraday cup to a current measuring system; and

wherein

said multiplicity of electrically conductive ring electrodes are arranged and electrically connected in at least three groups that are independently electrically biased for minimizing undesired charged particle leakage into or out of the faraday cup, and

each of the at least three groups of electrically connected ring electrodes comprises two or more ring electrodes.

18. (Original) The system for gas cluster ion beam processing of claim 15, wherein the gas cluster ion beam current is greater than 300 microamperes or wherein the gas cluster ion beam releases a gas flow greater than 20 standard cubic centimeters per minute at the strike plate of the faraday cup.

19. (Original) An improved system for gas cluster ion beam processing of surfaces of workpieces, comprising:

a vacuum chamber;

a gas cluster ion beam source disposed within the vacuum chamber for forming a gas cluster ion beam, said gas cluster ion beam having a beam axis;

a workpiece holder for holding a workpiece in the path of the gas cluster ion beam within the vacuum chamber for processing;

a low energy electron source within the vacuum chamber for at least partially neutralizing the space charge of the gas cluster ion beam; and

a vented faraday cup within the vacuum chamber for collecting the gas cluster ion beam current for measurement to control the processing of the workpiece.

20. (Original) The system for gas cluster ion beam processing of claim 19, wherein the low energy electron source comprises:

one or more filaments for emitting electrons;

an anode electrode for accelerating said electrons away from the one or more filaments and toward the gas cluster ion beam;

a deceleration electrode for decelerating said accelerated electrons;

a filament power supply for biasing said one or more filaments to induce electron emission;

an acceleration power supply for biasing said anode electrode with respect to said one or more filaments; and

means for biasing said deceleration electrode with respect to said one or more filaments.

21. (Canceled)

22. (Canceled)

23. (New) The system of claim 19, wherein the vented Faraday cup is adapted to facilitate escape of gas in directions lateral to the beam axis.

24. (New) The system of claim 19, wherein the vented Faraday cup includes an electrically conductive strike plate having a surface for receiving a gas cluster ion beam, and a vented enclosure surrounding and extending in front of the strike plate so as to define a cup, said

enclosure comprised of a plurality of substantially coaxial electrically conductive ring electrodes disposed with gaps between the ring electrodes.

25. (New) A vented Faraday cup, comprising:

an electrically conductive strike plate having a surface for receiving a gas cluster ion beam;

a vented enclosure surrounding and extending in front of the strike plate so as to define a cup having an open end adapted to receive a gas cluster ion beam.

26. (New) The Faraday cup of claim 25, wherein the vented enclosure is adapted to facilitate escape of gas in directions lateral to an axis of the gas cluster ion beam.

27. (New) The Faraday cup of claim 25, wherein the vented enclosure comprises a plurality of substantially coaxial, electrically conductive ring electrodes disposed with gaps between the ring electrodes, and

further wherein said plurality of ring electrodes are arranged and electrically connected in at least three groups of at least two ring electrodes, each group adapted for independent electrical biasing to minimize undesired charged particle leakage into or out of the cup.